State of Hawai'i
DEPARTMENT OF LAND AND NATURAL RESOURCES
Division of Aquatic Resources
Honolulu, Hawai'i 96813

June 8, 2007

Board of Land
and Natural Resources
Honolulu, Hawai'i

Request for Authorization and Approval to Issue a Papahānaumokuākea Marine National Monument Joint Research Permit to Dr. Carl Meyer, University of Hawai'i, Hawai'i Institute of Marine Biology (HIMB) for Access to State Waters to Conduct Top Predator Population Research Activities.

The Division of Aquatic Resources (DAR) hereby submits a request for your authorization and approval for issuance of a Papahānaumokuākea Marine National Monument Joint Research Permit to Dr. Carl G. Meyer, HIMB, pursuant to § 13-60.5, *Hawai'i Administrative Rules*, and § 187A-6, *Hawai'i Revised Statutes,* and all other applicable laws and regulations. The Research Permit, described below, will allow activity to occur in the NWHI State Marine Refuge (0-3 miles) waters surrounding Nihoa Island, French Frigate Shoals, Gardner Pinnacles, Laysan Island, Lisianski Island, Pearl and Hermes Atoll, and Kure Atoll to conduct top predator population research activities. The activities will occur from July 1, 2007 through September 31, 2007, as outlined below and in the attached permit application.

INTENDED ACTIVITIES

The purpose of the applicant's research is to provide Monument managers with empirical data on top predator movement patterns, spawning habitats and population sizes in Monument waters. This information will be valuable for selecting appropriate management strategies for these ecologically important animals. The research project has the following specific goals and objectives;

1. Download 21 underwater receivers currently stationed in the Monument to retrieve stored movement data from 122 top predators tagged with acoustic transmitters in 2005 & 2006.

2. Determine how widely these animals have ranged since September 2006.

3. Improve receiver coverage by deploying seven additional underwater receivers at French Frigate Shoals, Laysan, Pearl & Hermes Reef, Midway and Kure.

4. Equip up to 70 additional top predators with acoustic tags detectable by a listening array.

5. Determine the locations of ulua (*Caranx ignobilis*) spawning aggregation sites.

6. Deploy satellite tags on one tiger shark (*Galeocerdo cuvier*). These tags will reveal the geographic track followed by this animal, the depth at which it swims and whether it swims from the NWHI into adjacent ecosystems. These deployments will augment satellite tagging carried out in 2006.

PROCEDURES

All activities will be carried out by the principle investigator and an assistant. Researchers will access sites using small boats launched from the NOAA ship Hi'ialakai. Predator capture and tagging will be conducted exclusively from these small boats. Servicing of receivers will be done by snorkelers and SCUBA divers. Researchers will not require any terrestrial access or night operations. The chosen methods (remote acoustic monitoring, satellite telemetry and identification tagging) are ideal techniques for quantifying animal movements in remote, environmentally-sensitive locations because they have minimal environmental impact and require only occasional, brief access by researchers to study sites, yet provide continuous monitoring of animal movements at those sites.

(a) Deployment of underwater receivers
Researchers will create temporary receiver moorings at the sites described in the permit application using a system that has previously been empirically demonstrated to successfully withstand seasonal high surf. Moorings will consist of sand screws in areas of soft sediment, and chain around uncolonized substrate in hard bottom areas (live substrates will be avoided). Researchers will remove these moorings when acoustic monitoring is completed (receivers will be in place for at least 2 years).

(b) Data retrieval, reduction and analysis.
Researchers will download receivers currently deployed in Monument waters. Data downloading consists of interfacing the receiver to a computer via a magnetically coupled probe and the serial port of the computer, and can be accomplished in the field. Preliminary data reduction and analyses will commence onboard the ship after downloading.

(c) Deployment of transmitters

Researchers will implant acoustic transmitters into 5 species of top predator (3 shark and 2 fish species) at several locations within the Monument.

Predator handling & tagging activities will be carried out in accordance with the animal use protocols of the University of Hawai'i (protocol #05-053).

REVIEW PROCESS:

The permit application was received by the Division of Aquatic Resources on or before February 1, 2007. It was sent out for review and comment to the following scientific entities: Division of Aquatic Resources staff, Papahānaumokuākea Marine National Monument, NOAA Pacific Islands Regional Office (NOAA-PIRO), and United States Fish and Wildlife Service. The Office of Hawaiian Affairs (OHA), and the Kaho'olawe Island Reserve Commission (KIRC) were also consulted.

Comments received from the Scientific Community on the Research Permit are summarized as follows:

Two reviewers requested information on previous by-catch rates (incidental captures and mortalities), and suggested this information be included in the required post-cruise report.

One reviewer requested that if any Hawaiian monk seals are present in the area, all research activity should cease until the seal departs the area. Additionally, all interactions with seals, and any incidental by-catch mortalities of target and non-target fish species be reported.

Comments were received from the Native Hawaiian community are summarized as follows:

OHA reiterated its request that each research vessel have at least one cultural practitioner on board. Additionally, all future Papahānaumokuākea Marine National Monument permit applications should address impacts to cultural resources.

RESPONSE:

DAR staff contacted Dr. Meyer to discuss reviewer comments. Dr. Meyer currently reports catch by species, and mortalities, and these data were included in his 2006 post-cruise report. This information will be required in the 2007 post-cruise report. Additionally, the applicant has agreed to cease research operations if monk seals are present in the immediate vicinity.

A meeting was held between HIMB researchers and administrators, and DAR staff, to discuss reviewer (scientific, policy, and cultural) concerns. During this meeting, OHA's concerns were discussed. It was the consensus of those in attendance, that in order to address the requests from OHA, more information is required from OHA. Specifically, a list of acknowledged cultural practitioners who are available to accompany specific research cruises should be provided by OHA; additionally, a briefing for science researchers should be provided by OHA or a designate, to provide the information needed by individual applicants in order to address OHA's request for cultural impact analysis.

IMPACT ANALYSIS

Although some disturbances to Monument resources may be necessary to achieve the objectives of this project, the research should have minimal impact on Monument resources. The project will provide valuable information on the population structure of top predators within the Monument. Because the ecosystem on the NWHI is driven by top predator population dynamics, the value of this research far outweighs the minimal effects of the research activities.

FINAL STAFF RECOMMENDATIONS:

DAR staff is of the opinion that Applicant has properly demonstrated valid justifications for his application and should be allowed to enter the NWHI State Marine Refuge waters and to conduct the activities therein as specified in the application with the following special instructions and conditions, which are in addition to the Papahānaumokuākea Marine National Monument Joint Research Permit General Conditions:

1. Require Applicant to inform and consult with DAR regarding Applicant's cruise plan before each trip to the NWHI.

2. Species lists, by-catch, and mortality information must be reported in the post-cruise report.

3. Research operations must cease if monk seals are present in the immediate vicinity. No fishing is allowed in State Marine Refuge waters except as authorized under State law for subsistence, traditional and customary practices by Native Hawaiians.

4. To prevent introduction of disease or the unintended transport of live organisms, the permittee must comply with the disease and transport protocol attached to this permit.

5. Tender and dive vessels operating within the Monument are encouraged to operate at slow speed and with a bow lookout in shallow water coral reef areas in order to minimize prop or bow damage to three dimensional coral reef habitat or endangered monk seals or sea turtles. Tenders and small vessels must be equipped with engines that meet EPA emission requirements.

6. Refueling of tenders and all small vessels must be done at the NOAA R/V Hi'ialakai and outside the confines of the lagoons or near-shore waters.

7. This permit is not to be used for nor does it authorize the sale of collected organisms. Under this permit, the authorized research activity, including work involving a bioassay or bioprospecting, must be for non-commercial purposes, i.e., not involving the use or sale of any organisms, byproducts, or material

collected within the Monument for obtaining patents or intellectual property rights for profit.

8. The permittee may not convey, transfer, or distribute, in any fashion (including, but not limited to, selling, trading, giving, or loaning) any coral, live rock, or organism collected under this permit without the express written permission of the Co-Trustees.

RECOMMENDATION:

"That the Board authorize and approve, with stated conditions, a Research Permit to Dr. Carl Meyer."

Respectfully submitted,

DAN POLHEMUS
Administrator

APPROVED FOR SUBMITTAL

ALLAN A. SMITH
Interim Chairperson

Department of Land and Natural Resources
Northwestern Hawaiian Islands Permit Application Review

Permit Type: Management ☐ Recreation ☐ Research ☒
Education ☐ Cultural ☐ Special Ocean Use ☐

Working Title: Request for Authorization and Approval to Issue a Papahānaumokuākea Marine National Monument Joint Research Permit to Dr. Carl Meyer, Hawaii Institute of Marine Biology (HIMB) for Access to State Waters to Conduct Top Predator Population Research Activities.

Project Applicant: Carl G. Meyer, HIMB

Project Location(s) *(Both State Waters and Monument)*: Nihoa Island, French Frigate Shoals, Gardner Pinnacles, Laysan Island, Lisianski Island, Pearl and Hermes Atoll, and Kure Atoll.

Project Dates and Duration: July 7, 2007 through September 31, 2007
Project Précis & Background *(Summary of project and why this is proposed)*:

1. Download data from 21 underwater receivers currently stationed in the Monument to retrieve stored movement data from 122 top predators tagged with acoustic transmitters in 2005 & 2006. 2. Determine how widely these animals have ranged since September 2006. 3. Improve receiver coverage by deploying seven additional underwater receivers at French Frigate Shoals, Laysan, Pearl & Hermes Reef, Midway and Kure Atoll. 4 .Equip up to 70 additional top predators with acoustic tags detectable by the listening array. 5. Determine the locations of ulua (*Caranx ignobilis*) spawning aggregation sites.

2. Deploy satellite tags on one tiger shark. These tags will reveal the geographic track followed by this animal, the depth at which it swims and whether it swims from the NWHI into adjacent ecosystems. These deployments will augment satellite tagging carried out in 2006.

Are there other relevant permits that have/will be issued with regard to this project? No ☒

What is the relevance to management and/or the improved understanding of NWHI & MHI?

The purpose of Dr. Meyer's research is to provide Monument managers with empirical data on top predator movement patterns, spawning habitats and population sizes in Monument waters. This information will be valuable for selecting appropriate management strategies for these ecologically important animals.

Could work be conducted outside the NWHI?: Yes ☐ **No** ☒
Explain: Because this research seeks to elucidate the top predator population dynamics of this unique NWHI ecosystem, the research must be performed in-situ.

Has Applicant been granted a permit from the State in the past? Yes ☒
If so, please summarize past permits:

DLNR.NWHI06R03 was issued to Dr. Meyer on May 5, 2006. DLNR.NWHI06R019 was issued to Dr. Meyer on August 17, 2006. All terms in full compliance, including personnel updates, cruise log and report.

Have there been any a) violations: Yes ☐ No ☒ b) late/ incomplete reports: Yes ☐ No ☒
Any other relevant concerns from previous permits?_____

_____

Recommendations:
DAR Staff: Approve this permit application ☒ Reject this permit application ☐
NH CWG: Approve this permit application ☐ Reject this permit application ☐
Additional Comments:

Northwestern Hawaiian Islands Marine National Monument

Permit Application

NOTE: ***This Permit Application (and associated Instructions) are for activities to be conducted in the Northwestern Hawaiian Islands Marine National Monument, including Hawaiian Islands National Wildlife Refuge, the Midway Atoll National Wildlife Refuge, Battle of Midway National Memorial, Northwestern Hawaiian Islands State Marine Refuge, Kure Atoll Hawaii State Seabird Sanctuary, and the Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve. The Co-Trustees are required to determine that issuing the requested permit is compatible with the findings of Presidential Proclamation 8031. Within this Application, please provide all information that you believe will assist the Co-Trustees in determining how your proposed activities are compatible with the conservation and management of the natural, historical and cultural resources of the NWHI Marine National Monument (Monument).***

Summary Information

Applicant name: Carl G. Meyer

Permit categories:
☒ Research – Please fill out Sections A-D (as applicable) and Appendix A
☐ Conservation and Management - Please fill out Sections A-D (as applicable) and Appendix A
☐ Education - Please fill out Sections A-D (as applicable) and Appendix B
☐ Native Hawaiian Practices - Please fill out Sections A-D (as applicable) and Appendix C
☐ Recreation (Midway ONLY) - Please fill out Sections A-D (as applicable) and Appendix D
☐ Special Ocean Use - Please fill out Sections A-D (as applicable) and Appendix E

Briefly describe permit activity: **We are equipping coral reef top predators (sharks and large fishes) with transmitters and identification tags to determine their movement patterns, spawning habitats and population sizes within the Monument.**

☒ This application is for a RENEWAL of an existing permitted project.
☐ This application is for a NEW project.

When will the activity take place?
From: June 10, 2007 To: August 17, 2007

NOTE: INCOMPLETE APPLICATIONS WILL NOT BE CONSIDERED
Please Send Permit Applications to:
NWHI Marine National Monument Permit Coordinator
6600 Kalaniana'ole Hwy. # 300
Honolulu, HI 96825
Hoku.johnson@noaa.gov
PHONE: (808) 397-2660 FAX: (808) 397-2662

NOTE: SUBMITTAL VIA ELECTRONIC MAIL IS PREFERRED BUT NOT REQUIRED. FOR ADDITIONAL SUBMITTAL INSTRUCTIONS, PLEASE SEE PG 7.

Section A - Applicant Information

1. Applicant

Name (last, first, middle initial): Meyer, Carl G.

Title: Assistant Researcher

2. Mailing address (street/P.O. box, city, state, country, zip): PO Box 1346, Kaneohe, Hawaii, 96744

Phone: (808) 236-7477

Fax: (808) 236-7443

Email: carlm@hawaii.edu

For students, major professor's name, telephone and email address:

3. Affiliation (institution/agency/organization directly related to the proposed project):
Hawaii Institute of Marine Biology, University of Hawaii

4. Additional persons to be covered by permit:
Yannis Papastamatiou,
Zoology Department,
University of Hawaii,
Tel: 236-7449
Email: yannis@hawaii.edu

Section B: Project Information

5a. Project location(s):

☒ Nihoa Island	☐ Land-based	☒ Ocean-based
☐ Necker Island (Mokumanamana)	☐ Land-based	☐ Ocean-based
☒ French Frigate Shoals	☐ Land-based	☒ Ocean-based
☒ Gardner Pinnacles	☐ Land-based	☒ Ocean-based
☐ Maro Reef		
☒ Laysan Island	☐ Land-based	☒ Ocean-based
☒ Lisianski Island, Neva Shoal	☐ Land-based	☒ Ocean-based
☒ Pearl and Hermes Atoll	☐ Land-based	☒ Ocean-based
☒ Midway Atoll	☐ Land-based	☒ Ocean-based
☒ Kure Atoll	☐ Land-based	☒ Ocean-based
☐ Other		

NOTE: Please note there is a fee schedule for people visiting Midway Atoll National Wildlife Refuge via vessel and aircraft.

Location Description: Please refer to Appendix 1.

5b. Check all applicable regulated activities proposed to be conducted in the Monument:

☒ Removing, moving, taking, harvesting, possessing, injuring, disturbing, or damaging any living or nonliving monument resource

☒ Drilling into, dredging, or otherwise altering the submerged lands other than by anchoring a vessel; or constructing, placing, or abandoning any structure, material, or other matter on the submerged lands

☐ Anchoring a vessel

☐ Deserting a vessel aground, at anchor, or adrift

☐ Discharging or depositing any material or matter into the monument

☐ Touching coral, living or dead

☒ Possessing fishing gear except when stowed and not available for immediate use during passage without interruption through the monument

☒ Attracting any living monument resource

☐ Sustenance fishing (Federal waters only, outside of Special Preservation Areas, Ecological Reserves and Special Management Areas)

☐ Subsistence fishing (State waters only)

☒ Swimming, snorkeling, or closed or open circuit SCUBA diving within any Special Preservation Area or Midway Atoll Special Management Area

6. Purpose/Need/Scope ***State purpose of proposed activities:***

(a) Purpose of proposed activities

The purpose of our research is to provide Monument managers with empirical data on top predator movement patterns, spawning habitats and population sizes in Monument waters. This information will be valuable for selecting appropriate management strategies for these ecologically important animals. We have the following specific goals and objectives;

1. Download 21 underwater receivers currently stationed in the Monument to retrieve stored movement data from 122 top predators tagged with acoustic transmitters in 2005 & 2006.

2. Determine how widely these animals have ranged since September 2006.

3. Improve our receiver coverage by deploying seven additional underwater receivers at French Frigate Shoals, Laysan, Pearl & Hermes Reef, Midway and Kure (Appendix 1).

4. Equip up to 70 additional top predators with acoustic tags detectable by our listening array (see Table 1 - procedures). These tag deployments will enable us to reach adequate sample sizes for several under-sampled predator species (e.g., whitetip reef sharks), and to address one additional question (objective 5).

5. Determine the locations of ulua (*Caranx ignobilis*) spawning aggregation sites.

6. Deploy satellite tags on one tiger shark. These tags will reveal the geographic track followed by this animal, the depth at which it swims and whether it swims from the NWHI into adjacent ecosystems. These deployments will augment satellite tagging carried out in 2006.

7. Determine population sizes of ulua and uku (*Aprion virescens*) at Pearl & Hermes Reef using classical mark recapture methods.

(b) Need for proposed activities

Top predators play an important role in many ecosystems and in Monument waters this role is filled by sharks (primarily tiger, galapagos, gray reef and whitetip reef sharks) and large teleost fishes (primarily ulua) (DeCrosta 1981, Wetherbee et al. 1997, Friedlander & DeMartini 2002, Holzwarth et al. 2006). Previous NWHI studies have quantified top predator age and growth (Parrish et al. 1980, DeCrosta 1981, Sudekum et al. 1991,), reproduction (Parrish et al. 1980, Sudekum et al. 1991, Wetherbee et al. 1997), diet and trophic interactions (Sudekum et al. 1991, Wetherbee et al. 1997), and spatial distribution and density (Wetherbee et al. 1997, Friedlander & DeMartini 2002, DeMartini et al. 2005, Holzwarth et al. 2006). The movement patterns of top predators in the NWHI have received far less attention with previous scientific studies limited to short-term (<48h) acoustic tracks of 3 tiger sharks at French Frigate Shoals (Tricas 1981, Lowe et al. in press) and longer term acoustic monitoring of tiger sharks (N=14), galapagos sharks (N=10) and ulua (N=3) at French Frigate Shoals and Midway.

Science-based management of the marine top predators of the Hawaiian archipelago requires that we know whether key species are site-attached to specific areas or, if not, how

frequent and extensive are their movements. We are currently quantifying top predator movements in the NWHIMNM, and addressing three questions relevant to management zoning; (1) Do top predators move across open ocean between atolls?, (2) How extensive are their intra-atoll movements?, and (3) Do top predators exhibit predictable patterns of movement and habitat use? In 2005 & 2006 we equipped 122 top predators (6 species) with surgically-implanted acoustic transmitters and monitored their subsequent movements using 18 underwater receivers stationed on the seabed at 5 atolls within the Monument. In 2006 we also equipped 9 sharks (5 tiger sharks and 4 galapagos sharks) with satellite transmitters to monitor their movements in locations not equipped with acoustic receivers. Using these technologies we found that tiger sharks routinely swim between atolls, range along the entire Hawaiian archipelago and venture hundreds of miles beyond Monument boundaries into open-ocean. We also obtained the first empirical evidence that gray reef sharks swim across open-ocean between atolls. Other top predator species were site-attached to individual atolls, but wide-ranging within their 'home' atoll (e.g., Meyer et al., in press). We discovered that ulua & uku have predictable patterns of movement, including diel habitat shifts and tidal & lunar rhythmicity (Meyer et al., in press). We also found that during summer full moons, ulua from all over French Frigate Shoals atoll converge on one particular location where they form large spawning aggregations (Meyer et al., in press).

Although we have already made substantial progress in quantifying predator movement patterns in Monument waters, important questions remain unanswered. For example, we still know very little about the movement patterns of several top predators that are abundant in Monument waters (e.g., white tip reef shark, Hawaiian grouper). We also need to determine how documented movement patterns (e.g., ulua spawning migrations) vary over longer time scales. Our findings to date have also provided the foundation for addressing two additional important management questions; (1) Where do top predators such as ulua go to spawn?, and (2) How many predators are resident at each atoll? We need to identify ulua spawning aggregation sites because these may be critical habitats for this species. We need to quantify predator population sizes in order better understand their ecological impact (e.g., trophic impact and competitive influence on monk seals) and evaluate changes in population size over time. Previous estimates of predator abundance were derived from visual underwater surveys by divers (e.g., Friedlander & DeMartini 2002). These estimates may be heavily biased because Monument predators are attracted to divers. We are proposing a classical mark recapture assessment of ulua and uku population sizes at Pearl & Hermes Reef (see procedures). Our approach will provide managers with estimates of predator abundance that are not skewed by predator attraction to divers.

(c) Scope of proposed activities

We propose to continue monitoring our existing transmitter-equipped predators in order to determine how their movement patterns vary over multi year time-scales. This will require servicing and redeploying 21 existing receivers (see Appendix 1). We also propose deploying seven additional underwater receivers in Monument waters (see Appendix 1) in order to improve our monitoring coverage at several atolls and identify ulua spawning aggregation sites. We propose implanting acoustic transmitters into 10-20 additional individuals of four predator species for which our current sample size is too low to gain a robust understanding of their movement patterns (see procedures, section 8c). We also propose implanting an additional 10 ulua with acoustic tags to quantify spawning migrations at Pearl & Hermes Reef (PHR). Thus

we are requesting up to 70 additional acoustic transmitter deployments (all species combined). To estimate predator population sizes, we propose tagging (with external identification tags) up to 200 ulua, and up to 200 uku at PHR.

7. As explained further in the instructions, please provide any information that you believe will assist the Co-Trustees in determining how your proposed activities are compatible with the conservation and management of the natural, historical and cultural resources of the Monument:

We are addressing questions that are directly relevant to management of Monument resources (we are quantifying movements, spawning habitats and population sizes of top predators within Monument waters), hence the study must be carried out within the Monument. Our proposed research activities will have minimal impact on the resources and ecological integrity of the Monument. No animals will be removed from the Monument and we have empirical data showing that tagged predators resume normal patterns of behavior within hours of release (e.g., Meyer et. al. in press). Our receivers are stationed on uncolonized habitats, and removal will leave no evidence of their presence (see Appendix 3). The methods and procedures that we are proposing are ideal for achieving our goals with minimal impacts to Monument resources, qualities, and ecological integrity. The management value of data produced by our research activities outweighs the minor, transient impacts on Monument resources. The time frame of our proposed activities (at least 2 years) is consistent with our objectives of quantifying long-term movement patterns of Monument top predators. The principle investigator has more than a decade of experience conducting this type of research (see attached CV for details) and is well qualified to conduct and complete the activity and mitigate any potential impacts resulting from its conduct. Our study is funded by an award to Hawaii Institute of Marine Biology from the National Marine Sanctuary Program (MOA 2005-008/6882), and we are provided access to the Monument on the NOAA research vessel Hi'ialakai. Thus we have adequate financial resources available to conduct and complete the activity and mitigate any potential impacts resulting from its conduct. The Hi'ialakai carries a mobile transceiver unit approved by OLE and complies with the requirements of Presidential Proclamation 8031. There are no other factors that would make the issuance of a permit for our proposed activities inappropriate.

8. Procedures:
All activities will be carried out by the principle investigator and an assistant. We will access sites described in Appendix 1 using small boats launched from the NOAA ship Hi'ialakai. Predator capture and tagging will be conducted exclusively from these small boats. Servicing of receivers will be done by snorkelers and SCUBA divers. We will not require any terrestrial access or night operations. Our chosen methods (remote acoustic monitoring, satellite telemetry and identification tagging) are ideal for quantifying animal movements in remote, environmentally-sensitive locations because they have minimal environmental impact and require only occasional, brief access by researchers to study sites, yet provide continuous monitoring of animal movements at those sites.

(a) Deployment of underwater receivers
We will create temporary receiver moorings at the sites described in Appendix 1 using a system that has previously been empirically demonstrated to successfully withstand seasonal high surf.

Moorings will consist of sand screws in areas of soft sediment, and chain around uncolonized substrate in hard bottom areas (live substrates will be avoided). We will remove these moorings when acoustic monitoring is completed (receivers will be in place for at least 2 years). The receivers will be anchored to the moorings and suspended 1-4 m above the ocean floor. The receivers will identify and record the presence of any acoustic transmitters within range (up to 500 m). The transmitter number, time of arrival and departure and the date will be recorded and stored until the data are downloaded from the receivers to a computer. The receivers have a battery life of approximately 15 months and will be serviced at 6 to 12 month intervals.

(b) Data retrieval, reduction and analysis.
We will download receivers currently deployed in Monument waters (Appendix 1). Data downloading consists of interfacing the receiver to a computer via a magnetically coupled probe and the serial port of the computer, and can be accomplished in the field. Preliminary data reduction and analyses will commence onboard the ship after downloading.

(c) Deployment of transmitters
We will implant acoustic transmitters into 5 species of top predator (3 shark and 2 teleost species) at several locations within the Monument (Table 1).

Table 1. Predator species selected for tagging with acoustic transmitters.

Scientific Name	**Major Prey Groups**	**Location & Number of Animals**
Galeocerdo cuvier	Reef fishes, sharks, reef invertebrates, marine turtles, marine mammals	FFS (5), PHR (5), Kure (5)
Carcharhinus amblyrhynchos	Reef fishes, reef invertebrates	Nihoa (5), FFS (5), Gardner (5)
Triaenodon obesus	Reef fishes, reef invertebrates	FFS (10), PHR (10)
Caranx ignobilis	Reef fishes, reef invertebrates	Kure (10)
Epinephelus quernus	Reef fishes, reef invertebrates	PHR (10)

Our predator handling & tagging activities will be carried out in accordance with the animal use protocols of the University of Hawaii (protocol #05-053). We will capture target species (Table 1) by trolling (towing an artificial lure), handlining (using a single baited hook) from a small skiff, and using a bottom-set, 10 hook shark line (for large sharks). Captured predators will be brought alongside the skiff, tail-roped and inverted to initiate tonic immobility. In this trance-like condition, sharks and fishes remain docile while transmitters are surgically implanted. We will implant coded acoustic transmitters (V16, 9 mm diameter, 90 mm long, Vemco, Halifax, Nova Scotia) into the body cavities of each animal through a small incision in the abdominal wall (Holland et al., 1999; Meyer & Honebrink 2005, Meyer et al. in press). The incision will then be sutured closed, the hook removed and the animal released. This entire handling process can be completed in less than 10 minutes. Our acoustic transmitters have expected life spans of more than two years, thereby offering the possibility of detecting annual or seasonal patterns of movement and habitat use (Meyer et al. in press).

We will also equip one tiger shark with two types of satellite transmitter; (1) a fin mounted fixed transmitter (SPOT tag, 41 mm x 30 mm x 17 mm, weight 32 g, Wildlife Computers, Seattle), and (2) a pop-up archiving tag (PAT tag, length 180 mm, positively buoyant in water, Wildlife Computers, Seattle). SPOT tags transmit the shark's location to the Argos

satellite array whenever the dorsal fin breaks the surface of the water. PAT tags collect and store temperature, depth & light intensity data as the shark swims, and then detach from the animal on a preprogrammed date & time. The released PAT tag floats to the surface where it transmits archived data to the Argos satellite array. We will attach the SPOT tag by using a template to make two small (3 mm diameter) holes near the tip of the shark's dorsal fin, pushing short, threaded rods extending from the transmitter through these holes, and then securing the device on the opposite side of the fin with washers & bolts. We will attach the PAT tag using small titanium-steel darts that are inserted under the shark's skin at the base of the dorsal fin and locked in place through the dorsal ceratotrichia. Following transmitter attachment we will remove the hook and release the animal. The entire handling process can be completed in less than 15 minutes. Data transmitted by our satellite tags will be emailed to us on the day of transmission.

(d) Identification tagging to estimate population sizes of ulua and uku at PHR
Our acoustic monitoring data show that ulua and uku are resident at individual atolls (e.g., Meyer at al., in press) making these species good candidates for classical mark-recapture assessments of population size. We will use conventional identification tagging to estimate population sizes of ulua and uku at PHR. This activity will be carried out in two phases (1) capture, tagging and release of up to 200 tagged individuals per species at PHR during the June 10-30 research cruise, and (2) fishing to assess the proportion of tagged individuals within the general population at PHR, to be carried out during the July 25-August 17 cruise. We will capture ulua and uku for identification tagging using the trolling and handlining protocols described above. It is important to note that, unlike the recreational fishing methods suspected of impacting ulua populations at Midway Atoll (e.g. DeMartini et al., 2002), our fishing methods are designed to minimize capture stress. We will use heavy gauge tackle and barbless hooks to minimize handling time for captured fish (<5 min), and fish will remain in the water alongside the boat during tagging procedures. During phase 1, we will measure captured fish (Fork Length in cm) and tag them with serially-numbered plastic dart tags (Hallprint, South Australia). Tags will be inserted into the musculature just below the dorsal fin, so that the barb of the tag is anchored between the pterigiophores (Holland et al., 1996). Fish will then be unhooked and released. During phase 2, we will re-measure and record the tag numbers of any recaptured fishes.

Section C: Logistics

9. Other permits (list and attach documentation of all other related Federal or State permits):

Predator handling activities will be carried out under University of Hawaii IACUC protocol #05-053.

Previous predator tagging and remote monitoring activities in Monument waters were carried out under the following permits;

NOAA-NWHICRER permit # 2005-010
NOAA- NWHIMNM permit # 2006-012

U.S. Fish & Wildlife Special Use Permit # 12521-05020
U.S. Fish & Wildlife Special Use Permit # 12521-06021
U.S. Fish & Wildlife Special Use Permit # 12521-06048
State of Hawaii Department of Land and Natural Resources permit # DLNR.NWHI06R003
State of Hawaii Department of Land and Natural Resources permit # DLNR.NWHI06R019

9a. For each of the permits listed, please identify any permit violations or any permit that was suspended, amended, modified or revoked for cause. Please explain the circumstances surrounding the violation or permit suspension, amendment, modification or revocation.

Not applicable

10. Funding sources (Please attach copies of your budget, specific to proposed activities under this permit and include funding sources. Please see instructions for more information):

Our funding is provided by an award to Hawaii Institute of Marine Biology from the National Marine Sanctuary Program (MOA 2005-008/6882). We have allocated $77,000 for supplies required to implement our proposed objectives.

11. Time frame:
Activity start: May 2005
Activity completion: September 2009

Dates actively inside the Monument:

Cruise #1 (Nihoa, Gardner, Laysan, Lisianski, PHR, Midway, and Kure) June 10-30, 2007
Cruise #2 (FFS, PHR, Midway, and Kure.) July 25-August 17, 2007

Please describe any limiting factors in declaring specific dates of the proposed activity at the time of application: The dates above reflect preliminary cruise schedules for NOAA ship Hi'ialakai, and may be changed.

Personnel schedule in the Monument:

Carl Meyer (PI) and Yannis Papastamatiou will be at locations indicated above during the dates given. We do not have a more detailed schedule at this time.

12. Please indicate (with attached documentation) what insurance policies, bonding coverage, and/or financial resources are in place to pay for or reimburse the Monument trustees for the necessary search and rescue, evacuation, and/or removal of any or all persons covered by the permit from the Monument:

NOAA Ship HI`IALAKAI is a U.S. Government-owned and operated research vessel and is self-insured by the U.S. Government.

13. Please check the appropriate box to indicate how personnel will enter the Monument:

☒ Vessel
☐ Aircraft

Provide Vessel and Aircraft information: NOAA Ship HI`IALAKAI

14. What certifications/inspections do you have scheduled for your vessel? Please fill in scheduled date (attach documentation):

☐ Rodent free, Date: Will be provided by Hi'ialakai
☐ Tender vessel, Date: Will be provided by Hi'ialakai
☐ Ballast water, Date: Will be provided by Hi'ialakai
☐ Gear/equipment, Date: Will be provided by Hi'ialakai
☐ Hull inspection, Date: Will be provided by Hi'ialakai

15. Vessel information (NOTE: if you are traveling aboard a National Oceanic and Atmospheric Administration vessel, skip this question):
Vessel name:
Vessel owner:
Captain's name:
IMO#:
Vessel ID#:
Flag:
Vessel type:
Call sign:
Embarkation port:
Last port vessel will have been at prior to this embarkation:
Length:
Gross tonnage:
Total ballast water capacity volume (m3):
Total number of ballast water tanks on ship:
Total fuel capacity:
Total number of fuel tanks on ship:
Marine Sanitation Device:
Type :

How will you comply with the 'No Discharge' regulations stipulated in Presidential Proclamation 8031? Describe in detail. If applicable, please attach schematics of the vessel's discharge and treatment systems:

Other fuel/hazardous materials to be carried on board and amounts:

Please provide proof of a National Oceanic and Atmospheric Administration (NOAA) Office of Law Enforcement-approved Vessel Monitoring System (VMS). Please provide the name and contact information of the contractor responsible for installing the VMS system. Please also describe unit name and type:

VMS Email:
Inmarsat ID#:

16. Tender information:

On what workboats (tenders) will personnel, gear and materials be transported within the Monument? Please list the number of tenders/skiffs aboard and specific types of motors:

Ship's own tenders -	1 each 10 m AMBAR Marine jet boat with Yanmar 370-hp, Diesel inboard engine 1 each 8 m AMBAR Marine jet boat with Yanmar 315-hp, Diesel inboard engine 2 each 17.5 ft Zodiac inflatable boats, each with one Honda 50-hp, 4-stroke, outboard gasoline engine 1 each 19 ft AMBAR Marine rescue boat with Honda 115-hp, 4-stroke, outboard gasoline engine

With knowledge of the penalties for false or incomplete statements, as provided by 18 U.S.C. 1001, and for perjury, as provided by 18 U.S.C. 1621, I hereby certify to the best of my abilities under penalty of perjury of that the information I have provided on this application form is true and correct.

_____ 1-23-2007_____
Signature Date

PLEASE SEND ONE SIGNED APPLICATION VIA MAIL TO THE MONUMENT OFFICE BELOW:

NWHI Marine National Monument Permit Coordinator
6600 Kalaniana'ole Hwy. # 300
Honolulu, HI 96825
FAX: (808) 397-2662

DID YOU INCLUDE THESE?

- ☒ Applicant CV/Resume/Biography
- ☐ Electronic and Hard Copy of Application with Signature
- ☒ Map(s) or GPS point(s) of Project Location(s), if applicable
- ☐ Funding Proposal(s)
- ☐ Funding and Award Documentation, if already received
- ☐ Documentation of Insurance, if already received
- ☐ Documentation of Inspections
- ☐ Documentation of all required Federal and State Permits or applications for permits
- ☐ Statement of information you wish to be kept confidential

Appendix A: Research OR Conservation and Management Application

NOTE: If land or marine archeological activities are involved, please contact the Monument Permit Coordinator at the address on the general application form before proceeding, as a customized application will be needed. For more information, please contact the Monument office on the first page of this application.

1a. Collection of specimens - collecting activities (would apply to any activity): organisms or objects (List of species, if applicable, attach additional sheets if necessary): N/A

Common name: N/A

Scientific name: N/A

& size of specimens: N/A

Collection location: N/A

☐ Whole Organism ☐ Partial Organism N/A

1b. What will be done with the specimens after the project has ended? N/A

1c. Will the organisms be kept alive after collection? ☐ **Yes** ☐ **No** N/A

• Specific site/location: N/A

• Is it an open or closed system? ☐ Open ☐ Closed N/A

• Is there an outfall? ☐ Yes ☐ No N/A

• Will these organisms be housed with other organisms? If so, what are the other organisms? N/A

• Will organisms be released? N/A

2. If applicable, how will the collected samples or specimens be transported out of the Monument? N/A

3. Describe collaborative activities to share samples, reduce duplicative sampling, or duplicative research: N/A

4a. Gear and materials: Please refer to Appendix 2

4b. Please list all Hazardous Materials you propose to take to and use within the Monument: N/A

5. Fixed installations and instrumentation: Please refer to Appendix 3

6. Provide a time line for sample analysis, data analysis, write-up and publication of information:

Analyses & interpretation of data are ongoing. We already have two manuscripts in press in international peer reviewed journals. We have a 3rd manuscript currently in review;

Meyer CG, Holland KN, Papastamatiou YP (In Press) Seasonal and diel movements of giant trevally (*Caranx ignobilis*) at remote Hawaiian atolls: implications for the design of Marine Protected Areas. **Marine Ecology Progress Series**.

Meyer CG, Holland KN, Papastamatiou YP (In Review) Seasonal, diel and tidal movement patterns of green jobfish (*Aprion virescens*, Lutjanidae) at remote Hawaiian atolls: Implications for Marine Protected Area design. **Marine Biology**.

Papastamatiou YP, **Meyer CG**, Maragos JE (In Press) Sharks as cleaners for reef fish. **Coral Reefs**.

7. List all publications directly related to the proposed project:

DeCrosta MA (1981). Age determination and growth of three species of shallow-water carcharhinid sharks in Hawaii. Pacific Science 35:266-267.

DeMartini EE, Parrish FA, Boland RC (2002) Comprehensive evaluation of shallow reef fish populations at French Frigate Shoals and Midway Atoll, Northwestern Hawaiian Islands (1992/93, 1995–2000). NOAA Technical Memorandum NOAA Tech Memo NMFS SWFSC-347:1-54

DeMartini EE, Friedlander AM and SR Holzwarth (2005). Size at sex change in protogynous labroids, prey body size distributions, and apex predator densities at NW Hawaiian atolls. Marine Ecology Progress Series 297: 259-271.

Holzwarth SR, DeMartini EE, Zgliczynski BJ, Laughlin JL (2006) Sharks and jacks in the Northwestern Hawaiian Islands from towed-diver surveys 2000-2003. Atoll Research Bulletin 543: 257-280.

Friedlander AM and EE DeMartini (2002). Contrasts in density, size, and biomass of reef fishes between the northwestern and the main Hawaiian islands: the effects of fishing down apex predators. Marine Ecology Progress Series 230:253-264.

Holland KN, Lowe CG and BM Wetherbee (1996). Movements and dispersal patterns of blue trevally (*Caranx melampygus*) in a fisheries conservation zone. Fisheries Research 25: 279-292.

Holland KN, Wetherbee BM, Lowe CG and CG Meyer (1999) Movements of tiger sharks (*Galeocerdo cuvier*) in coastal Hawaiian waters. Marine Biology 134: 665-673.

Holland, KN, AC Bush, CG Meyer, SM Kajiura, BM Wetherbee & CG Lowe (2001). Five tags applied to a single species in a single location: the tiger shark experience. pp. 237-247 in JR Sibert & JL Nielsen, eds. Electronic tagging and tracking in marine fisheries. Kluwer Academic Publishers, The Netherlands.

Lowe CG, Wetherbee BM, Meyer CG (2006) Using acoustic telemetry monitoring techniques to quantify movement patterns and site fidelity of sharks and giant trevally around French Frigate Shoals and Midway Atoll. Atoll Research Bulletin 543: 281-303

Meyer CG and R Honebrink (2005) Retention of surgically implanted transmitters by bluefin trevally (*Caranx melampygus*). Implications for long-term movement studies. Transactions of the American Fisheries Society. 134:602-606.

Meyer CG, Holland KN, Papastamatiou YP. In Press. Seasonal and diel movements of giant trevally (*Caranx ignobilis*) at remote Hawaiian atolls: implications for the design of Marine Protected Areas. Marine Ecology Progress Series.

Parrish J, Taylor L, DeCrosta M, Feldkamp S, Sanderson L and C Sorden (1980). Symposium on Status of Resource Investigations in the Northwestern Hawaiian Islands. pp. 175-188.

Randall JE (1977). Contribution to the biology of the whitetip reef shark (Triaenodon obesus). Pacific Science 31:143-164.

Sudekum AE, Parrish JD, Radtke RL and S Ralston (1991). Life history and ecology of large jacks in undisturbed, shallow, oceanic communities. Fishery Bulletin 89: 493-513.

Tricas TC, Taylor LR and G Naftel. (1981). Diel behavior of the tiger shark, Galeocerdo cuvier, at French Frigate Shoals, Hawaiian Islands. Copeia 1981:904-908.

Wetherbee BM, Crow GL and CG Lowe. (1996). The biology of the Galapagos shark, Carcharhinus galapagensis, in Hawaii. Environmental Biology of Fishes. 45:299-310.

Wetherbee BM, Crow GL and CG Lowe (1997). Distribution, reproduction and diet of the gray reef shark Carcharhinus amblyrhynchos in Hawaii. Marine Ecology Progress Series 151: 181-189.

Wetherbee, BM, KN Holland, CG Meyer and CG Lowe. (2004). Use of a marine reserve in Hawaii by the giant trevally, Caranx ignobilis. Fisheries Research 67:253-263.

DID YOU INCLUDE THESE?

☐ Material Safety Data Sheets for Hazardous Materials N/A

CURRICULUM VITAE
CARL GUSTAV MEYER

Hawaii Institute of Marine Biology • PO Box 1346 • Kaneohe HI 97644
Tel: 808-236-7477 • Fax: 808-236-7443 • Email: carlm@hawaii.edu

TITLES

Assistant Researcher, Hawaii Institute of Marine Biology, University of Hawaii.

EDUCATION

Ph.D. (*Zoology*), University of Hawaii at Manoa. "Evaluating the effectiveness of small marine reserves. Waikiki Marine Life Conservation District as a case study.", 2003.
Advisor: Dr. Kim Holland.

M.Phil. (*Biological Sciences*), University of Plymouth, England. "Biology and fishery of the spider crab, *Maja squinado*, around Jersey (Channel Islands)", 1993.
Advisor: Dr. Malcom Jones.

B.Sc. Hons. (*Biological Sciences*), University of Plymouth, England, 1990.
Advisor: Dr. Peter Reay.

GRANTS AND AWARDS

2005-2006 **NOAA General Coral Reef Conservation Grant**: Acoustic monitoring of long-term movement patterns, habitat use and site fidelity of coral reef fishes: Implications for Marine Protected Area design (P.I.: $28,750).

2005-2006 **Hawaii Sea Grant Program**: Foraging ecology and movement patterns of blacktip reef sharks at Palmyra atoll (P.I.: $9.975).

2001 University of Hawaii, **26th Annual Albert L. Tester Memorial Symposium**, Best Student Paper Award.

RESEARCH EXPERIENCE

Assistant Researcher. *University of Hawaii, Joint Institute for Marine and Atmospheric Research.* August 2003 – Present.

- 2005-2006 Ultrasonic & satellite tagging study of marine top predator movements in the Northwest Hawaiian Islands.
- 2005-2006 Ultrasonic tagging study of coral reef fish movements in Kealakekua Bay Marine Life Conservation District.
- 2003-2005 Experimental investigation of the shark compass sense.
- 2003-2005 Research and development of new electronic telemetry tags.
- 2003-2005 Ultrasonic tagging study of tiger shark movements in Hawaii.

Collaborator. *Hawaii Division of Aquatic Resources Ulua Tracking Project.* 2003-2004.

- Acoustic monitoring study of jack (Carangidae) movements in West Hawaii.

Research Assistant. *University of Hawaii, Hawaii Institute of Marine Biology.* 1993-2003.

- 2001- 2003 Quantified human activities and impacts in four Hawaii Marine Protected Areas using a novel Geographic Information System (GIS) approach.
- 1997-2001 Conducted underwater visual censuses of reef fish populations in and around Waikiki marine reserve.
- 1999-2001 Quantified fishing and other marine recreational activities along the Kewalo-Waikiki-Diamond Head shoreline (south coast of Oahu, Hawaii).
- 1997-2001 Quantified movement patterns, home range sizes, habitat use and dispersal of reef fishes in Waikiki Marine Life Conservation District (a no-fishing marine reserve) using ultrasonic and conventional identification tags.
- 1993-2001 Assisted with shark long lining, tagging and ultrasonic tracking around the Main Hawaiian Islands.
- 1995-1996 Collected gonads and otoliths from commercially targeted coral reef fishes around Oahu.
- 1993-1996 Assisted with reef fish tagging and tracking around Coconut Island (Kaneohe Bay, Oahu).
- 1993-1995 Collected diet data from jacks captured during three annual recreational fishing tournaments designed to gather scientific data.

Collaborator. *French Frigate Shoals Tiger Shark Research Project.* 1999-2003.

- Participated in acoustic monitoring study of tiger shark behavior at French Frigate Shoals Atoll.

Fisheries Biologist. *Department of Agriculture and Fisheries, Jersey (Channel Islands).* 1990 – 1993.

- 1992-1993 Assisted with design and implementation of fishing licensing scheme for local fishing fleet. Carried out survey of commercial and recreational fishing activities.
- 1992 Organized First International Majid Crab Conference.
- 1990-1993 Mapped nursery areas and elucidated juvenile life history of spider crabs (*Maja squinado*).

- 1991-1993 Experimentally tested size selectivity and discard damage rates of spider crab tangle nets.

- 1990-1993 Quantified catch and effort in the commercial spider crab fishery, and participated in spider crab stock assessment cruise.

- 1992-1993 Compared effectiveness of different methods of measuring minimum legal size (MLS) of European lobsters (*Homarus gammarus*).

Undergraduate honors project – *University of Plymouth, England*

- 1988-1989 Quantified vertical distribution and habitat preferences of intertidal fishes in Jersey (Channel Islands).

PUBLICATIONS

1. Peer Reviewed

Meyer CG, Holland KN, Papastamatiou YP. In Press. Seasonal and diel movements of giant trevally (*Caranx ignobilis*) at remote Hawaiian atolls: implications for the design of Marine Protected Areas. ***Marine Ecology Progress Series***

Meyer CG. In Press. The impacts of spear and other recreational fishers on a small permanent Marine Protected Area and adjacent pulse fished area. ***Fisheries Research***.

Papastamatiou YP, **Meyer CG**, Maragos JE. In Press. Sharks as cleaners for reef fish. ***Coral Reefs***.

Lowe CG, BM Wetherbee and **CG Meyer**. 2006. Using acoustic telemetry monitoring techniques to quantify movement patterns and site fidelity of sharks and giant trevally around French Frigate Shoals and Midway Atoll. ***Atoll Research Bulletin*** 543: 281-303

Meyer CG and KN Holland. 2005. The role of movement patterns, home range size and site fidelity in greater abundance and size of bluespine unicornfish (*Naso unicornis*; Acanthuridae) in a small marine reserve. ***Environmental Biology of Fishes*** 134 (3): 602-606.

Meyer CG & R Honebrink. 2005. Retention of surgically implanted transmitters by bluefin trevally (*Caranx melampygus*). Implications for long-term movement studies. ***Transactions of the American Fisheries Society*** 134: 602-606.

Meyer CG, Holland KN & YP Papastamatiou. 2005. Sharks can detect changes in the geomagnetic field. ***Journal of the Royal Society Interface*** 2: 129–130.

Wetherbee BM, KN Holland, **CG Meyer** and CG Lowe. 2004. Use of a marine reserve in Hawaii by the giant trevally, *Caranx ignobilis*. ***Fisheries Research*** 67:253-263.

Meyer CG and KN Holland. 2001. A kayak method for tracking fish in very shallow water. ***Reviews in Fish Biology and Fisheries***. *In:* J.R. Sibert and J. Nielsen (Eds.), Electronic Tagging and Tracking in Marine Fisheries (pp. 289-296). Kluwer Academic Publishers, The Netherlands.

Holland, K., A. Bush, **C. Meyer**, S. Kajiura, B. Wetherbee, and C. Lowe. 2001. Five tags applied to a single species in a single location: The tiger shark experience. ***Reviews in Fish Biology and Fisheries***. *In:* J.R. Sibert and J. Nielsen (Eds.), Electronic Tagging and Tracking in Marine Fisheries (pp. 237-248). Kluwer Academic Publishers, The Netherlands.

Meyer CG, KN Holland, BM Wetherbee, and CG Lowe. 2001. Diet, resource partitioning and gear vulnerability of Hawaiian jacks captured in fishing tournaments. ***Fisheries Research*** 53:105-113.

Meyer CG, KN Holland, BM Wetherbee, and CG Lowe. 2000. Movement patterns, habitat utilization, home range size and site fidelity of whitesaddle goatfish (*Parupeneus porphyreus*) in a marine reserve. ***Environmental Biology of Fishes*** 59: 235-242.

Holland KN, BM Wetherbee, CG Lowe and **CG Meyer**. 1999. Movements of tiger sharks (*Galeocerdo cuvier*) in coastal Hawaiian waters. ***Marine Biology*** 134: 665-675.

2. Technical Reports

Holland KN and **CG Meyer**. 2003. Human Activities in Marine Protected Areas - Impact on Substrates. Final Report. Honolulu, HI: Division of Aquatic Resources, Department of Land and Natural Resources, State of Hawaii, 37 pp

Holland KN and **CG Meyer**. 2002. Hawaii Marine Protected Areas Usage Survey – Final Report. Honolulu, HI: Division of Aquatic Resources, Department of Land and Natural Resources, State of Hawaii, 20 pp

Holland KN and **CG Meyer**. 2002. Fishing Activity and its Impact on the Efficacy of Marine Protected Areas. Final Report. Hawaii Coral Reef Initiative, 8pp

Meyer CG and SM Clark. 2000. A preliminary analysis of human activity patterns in the Waikiki Fisheries Management Area and Marine Life Conservation District. Final Report. Honolulu, HI: Division of Aquatic Resources, Department of Land and Natural Resources, State of Hawaii, 20 pp

Meyer CG and KN Holland. 1996. Harvest refugia as fisheries management tools: empirical data on fish movement patterns, habitat use and dispersal. Proceedings of the Western Association of Fish and Wildlife Agencies 76: 200-207.

Meyer CG 1992. Seasonal variation in composition of trap catches of the spider crab (*Maja squinado*, Herbst, 1788) in a known inshore nursery area on the south coast of Jersey (British Channel Islands). International Council for the Exploration of the Sea, Copenhagen (Denmark). Shellfish Committee Meeting Papers. 10 pp.

Bossy SF, Le Blancq DJ and **Meyer CG** 1992. A comparison between the use of total length and carapace length for measuring the minimum legal landing size for the European lobster (*Homarus gammarus* L.). International Council for the Exploration of the Sea, Copenhagen (Denmark). Shellfish Committee Meeting Papers. 3 pp.

3. Book Chapters

Meyer CG 2001. A day in the life of a marine biologist. pp 18-19 In: Ocean Watch. Dorling Kindersly Publishing Inc., New York, NY.

Holland KN, CG Lowe, BM Wetherbee, AC Bush and **CG Meyer**. 1998. Sharks and people. pp. 124-153 In: Sharks. Reader's Digest Association, Pleasantville, NY.

REVIEWER

Aquatic Living Resources
California Sea Grant
Caribbean Journal of Science
Environmental Biology of Fishes
Fisheries Research
Hawaii Academy of Science
Journal of Fish Biology
Journal of Shellfish Research
Marine and Freshwater Research
Marine Biology
Marine Ecology Progress Series
National Science Foundation

INVITED PRESENTATIONS

2005 *Using GIS to Assess Marine Reserve Effectiveness*, California State University at Long Beach.

2004 *Evaluating the Effectiveness of Small Marine Reserves*, Leeward Community College, Hawaii.

2004 *Shark movement patterns in the Hawaiian Islands*, Hawaii Sharks Teachers Conference, Hawaii Institute of Marine Biology.

2003 *Reef Fish Movements & Habitat Use*, Hawaii Coral Reef Fishery Management Workshop.

2001 *Tiger shark research in Hawaii*, Hawaii Annual Ocean Safety Conference.

2001 *Why we need marine reserves*, Malama Ohana, Hawaii.

2001 *Reef Fish Migrations*, Waikiki Aquarium, 2001

ADVISORY POSITIONS

Scientific Advisor - Pupukea Marine Life Conservation District task force, 2001-2002.

Participant - Hawaii Marine Protected Area working group, 2002-2003.

Curriculum Vitae
Yannis P. Papastamatiou

ADDRESS:
Department of Zoology
University of Hawaii at Manoa
Hawaii Institute of Marine Biology, PO Box 1346, Kaneohe, HI 96744, USA

Tel: (808) 236 7449
Fax: (808) 236 7443
Email: yannis@hawaii.edu

BIRTH: 05 Nov 1977, London UK

EDUCATION:
2003-present: working towards a PhD in Zoology at the University of Hawaii at Manoa
2000-2003: Masters of Science in Biology, California State University Long Beach. GPA: 4.0
1995-1998: Bachelors of Science, Major in Oceanography with Marine Biology, University of Southampton, UK.

Work Experience:
2003-present: Boat and dive safety coordinator for Hawaii Institute of Marine Biology
2000-2002: Teaching Associate for California State University Long Beach: Taught biology labs for both majors and non-majors.
2001-2002: Scuba Instructor for Southern California Institute of Marine Sciences: co-taught AAUS sanctioned research dive classes
1999: Intern for the International Shark Attack File, University of Florida

RESEARCH INVOLVEMENT:
2004-present: Digestive physiology, foraging ecology and movement patterns of blacktip reef sharks (*Carcharhinus melanopterus*)
2003: Movements of pelagic fish and sharks in Hawaiian waters
2002: Digestive physiology of leopard sharks (*Triakis semfasciata*)
2002: Movement patterns of pelagic and reef fish around Catalina Island, California
2002: Site fidelity of deepwater rockfish around an oilrig in the Santa Barbara Channel.
2001: Movement patterns of tiger sharks (*Galeorcerdo cuvier)* around the North Western Hawaiian Islands.
2001: Population dynamics and spine re-growth of the round stingray (*Urolophus halleri*) at Seal Beach, California
1999: Population dynamics of great white sharks at Dyer Island, South Africa
1999: Shark attacks in the Mediterranean Sea
1998: Population structure and reproductive biology of the cold seep mussel, *Bathymodiolus N sp.*

GRANTS:

2006: National Geographic Society: Digestive physiology and foraging ecology of blacktip reef sharks at Palmyra atoll
2004: PADI project AWARE: measuring digestive variables in free-swimming sharks.
2002: Discovery channel documentary, "Sharks behind glass":
2002: Marine Conservation Research Institute-Aquarium of the Pacific
Gastric pH changes associated with feeding in leopard sharks..
2001: British Discovery Channel, "The science of shark attack"
2001: PADI Project AWARE: Gastric pH changes associated with feeding and the use of a pH sensing acoustic transmitter to determine feeding periodicity in sharks.

ACADEMIC AWARDS:

2003: Graduate Deans list for the College of Natural Sciences and Mathematics, California State University Long Beach
2003: Boeing foundation graduate student award.
2002: First place runner up for best student paper. American Institute of Fisheries Research Biologists, Southern California Academy of Sciences meeting.
2001: American Chemistry Society for Polymer (organic) Chemistry.
2001: SCTC Marine Biology Foundation.
2000: Donald Nelson award for elasmobranch biology, American Elasmobranch Society.

PEER REVIEWED PUBLICATIONS:

Lowe C, G Moss, G Hoisington, J Vaudo, D Cartamil, M Marcotte, **Y Papastamatiou**. 2007. Caudal spine replacement in the round stingray, *Urobatus halleri:* implications for management of human injuries. Bulletin of the Southern California Academy of Science. In Press

Papastamatiou Y, C Meyer, J Maragos. 2007. Sharks as cleaners for reef fish. Coral Reefs. In Press

Papastamatiou Y. 2007. The potential influence of gastric acid secretion during fasting on digestion time in leopard sharks (*Triakis semifasciata*). Comparative Biochemistry and Physiology A. In Press

Meyer C, K Holland, **Y Papastamatiou.** 2006. Seasonal and diel movements of giant trevally (*Caranx ignobilis*) at remote Hawaiian atolls: implications for the design of marine protected areas. Marine Ecology Progress Series. In Press

Papastamatiou Y, B Wetherbee, C Lowe, G Crow. 2006. Distribution and diet of four species of Carcharhinid shark in the Hawaiian Islands: evidence for resource partitioning and competitive exclusion. Marine Ecology Progress Series. 320: 239-251

Papastamatiou Y, C Lowe. 2005. Variations in gastric acid secretion during periods of fasting between two species of shark. Comparative Biochemistry and Physiology A 141: 210-214

Meyer C, K Holland, **Y Papastamatiou**. 2005. Sharks can detect changes in the geomagnetic field. Journal of the Royal Society Interface 2: 129-130

Papastamatiou Y, C Lowe. 2004. Postprandial response of gastric pH in leopard sharks (*Triakis semifasciata*) and its use to study foraging ecology. Journal of Experimental Biology 207: 225-232

Lowe C, D Topping, D Cartamil, **Y Papastamatiou.** 2003. Movement patterns, home range and habitat utilization of kelp bass (*Paralabrax clathratus*) in a temperate no-take marine reserve. Marine Ecology Progress Series. 256: 205-216

ABSTRACTS:

Lowe, Christopher G., A. Friedlander, J. Beets, J. Caselle, and **Y. Papastamatiou**. July 2005. Movements of blacktip reef sharks (*Carcharhinus melanopterus*) in lagoons at Palmyra Atoll. American Elasmobranch Society. Tampa, Florida

Papastamatiou Y, C Lowe, K Holland. July, 2005. Variations in the response of gastric acid secretion during periods of fasting between shark species. American Elasmobranch Society. Tampa, Florida

.

Papastamatiou Y, C Lowe. June, 2003. Using pH to study the foraging ecology of sharks. American Elasmobranch Society. Manaus, Brazil

Papastamatiou Y, C Lowe, K Kelley. January, 2003. Gastric pH changes associated with feeding in leopard sharks. Using pH to study the foraging ecology of sharks. Society of Integrative and Comparitive Biologists. Toronto, Canada

Papastamatiou Y, C Lowe. November, 2002. Using pH to study the foraging ecology of sharks. Western Society of Naturalists. Monterey, California

Papastamatiou Y, C Lowe. June, 2002. *In situ* measurements of gastric pH in leopard sharks (*Triakis semifasciata).* Southern California Academy of Science. Claremont, California

Lowe C, D Topping, C Snellen, D Cartamil, **Y Papastamatiou,** G Moss. April, 2001.You've got to know where they go: home range and habitat use of kelp bass (*Paralabrax clathratus*) in Big Fisherman's cove marine reserve, Santa Catalina Island, California. American Fisheries Society. Santa Rosa, California

Lowe, C.G., G. Moss, G. Hoisington, J. Vaudo, D. Cartamil, **Y Papastamatiou,** D. Topping, M.Marcotte, and K. Anthony. November, 2001. Rate of barb regeneration and population size of round stingrays at Seal Beach, California. Western Society of Naturalists. Ventura, California.

PROFESSIONAL SOCIETIES:
American Elasmobranch Society
American Association of Underwater Scientists (AAUS)
American Institute of Fisheries Research Biologist
Western Society of Naturalists
Society of Integrative and Comparative Biologists
Sigma-xi

APPOINTMENTS AND ELECTED POSITIONS:
Dive Safety Board-Hawaii Institute of Marine Biology
Ocean Studies Institute Diving Control Board –student board representative.

SKILLS:

SCUBA diving: PADI Open Water Scuba Instructor (active teaching status), PADI Specialty Instructor (Deep, Night, Navigation, Naturalist and Wreck specialties), NAUI Nitrox, AAUS (American Association of Underwater Scientists) certified, BSAC (British Sub-Aqua Club) Diveleader, BSAC Dive Planning and Marshalling, ScubaPro regulator technician, IANTD Nitrox/trimix Gas Blender, IANTD Technical/trimix diver. Work experience as a divemaster/Instructor in Greece, UK, South Africa and the US
First Aid: PADI Medic First Aid/CPR Instructor (inactive teaching status), DAN O_2 administration license
Boats: RYA level 2 Powerboat license
Computers: Geographic Information Systems (Arcview), Computer modeling (STELLA)
Languages: English, Greek

Appendix 1 Description of Activity Locations

We are requesting three general categories of activities;

1. Servicing underwater receivers that are currently deployed in the NWHIMNM
2. Deploying additional underwater receivers
3. Capturing and tagging top predators

(1) We would like to recover, download and redeploy 21 receivers deployed at the following locations;

Atoll	Latitude	Longitude	Depth (ft)	Habitat
Nihoa	23.061083	-161.930800	55	Uncolonized hard bottom
FFS	23.635090	-166.185700	85	Sand
FFS	23.769450	-166.262083	30	Uncolonized hard bottom
FFS	23.786860	-166.207090	10	Sand
FFS	23.866640	-166.288200	15	Sand
FFS	23.869453	-166.241583	10	Sand
Gardner	24.998340	-167.999820	47	Uncolonized hard bottom
Laysan	25.754633	-171.715617	60	Sand
Laysan	25.773950	-171.742483	30	Sand
Lisianski	25.882367	-173.915733	85	Sand
Lisianski	26.057283	-173.959567	14	Sand
P&H	27.752900	-175.948050	50	Uncolonized hard bottom
P&H	27.787017	-175.836233	30	Uncolonized hard bottom
P&H	27.790917	-175.863000	35	Uncolonized hard bottom
P&H	27.910950	-175.908900	50	Uncolonized hard bottom
Midway	28.191167	-177.394500	30	Uncolonized hard bottom
Midway	28.197417	-177.362722	40	Uncolonized hard bottom
Midway	28.276639	-177.372139	8	Sand
Kure	28.381833	-178.308600	60	Uncolonized hard bottom
Kure	28.388889	-178.359583	45	Uncolonized hard bottom
Kure	28.452150	-178.315233	12	Sand

(2) To improve our monitoring coverage, we would like to deploy 7 additional receivers in the following locations;

Atoll	Latitude	Longitude	Depth (ft)	Habitat
FFS	23.880460	-166.289810	80	Uncolonized hardbottom
FFS	23.723930	-166.047900	70	Uncolonized hardbottom
Laysan	25.678790	-171.770270	70	Uncolonized hardbottom
PHR	27.901224	-175.723106	70	Uncolonized hardbottom
PHR	27.797959	-176.009912	90	Uncolonized hardbottom
Midway	28.281310	-177.372790	80	Uncolonized hardbottom
Kure	28.456476	-178.325554	80	Uncolonized hardbottom

(3) We will troll and handline to capture top predators. These activities will occur from a moving boat in the general vicinity of the following locations;

Atoll	Latitude	Longitude	Depth (ft)	Habitat
FFS	23.635090	-166.185700	85	Sand
FFS	23.769450	-166.262083	30	Uncolonized hard bottom
FFS	23.786860	-166.207090	10	Sand
FFS	23.869453	-166.241583	10	Sand
Gardner	24.998340	-167.999820	47	Uncolonized hard bottom
Laysan	25.773950	-171.742483	30	Sand
Lisianski	25.882367	-173.915733	85	Sand
Lisianski	26.057283	-173.959567	14	Sand
P&H	27.752900	-175.948050	50	Uncolonized hard bottom
P&H	27.787017	-175.836233	30	Uncolonized hard bottom
P&H	27.790917	-175.863000	35	Uncolonized hard bottom
P&H	27.910950	-175.908900	50	Uncolonized hard bottom
Kure	28.381833	-178.308600	60	Uncolonized hard bottom
Kure	28.388889	-178.359583	45	Uncolonized hard bottom
Kure	28.452150	-178.315233	12	Sand

We will deploy bottom-set hooks to capture large sharks at the following locations;

Atoll	Latitude	Longitude	Depth (ft)	Habitat
FFS	23.63422000	-166.18478000	200	Sand
FFS	23.64781667	-166.20190000	200	Sand
FFS	23.88253333	-166.29235000	250	Sand
FFS	23.88931667	-166.25311667	250	Sand
FFS	23.88933333	-166.25310000	250	Sand
P&H	27.78350000	-175.87650000	250	Sand
P&H	27.78411667	-175.87561667	250	Sand
P&H	27.78705000	-175.87075000	250	Sand
P&H	27.78733333	-175.87000000	250	Sand
Kure	28.39883333	-178.38983333	250	Sand

Appendix 2 Itemized list of gear and materials

Diving gear (will be transported in and out of Monument)

3 BCDs
3 Regulators
2 Weightbelts
3 Pairs of fins
4 Masks
2 Snorkels
2 Dive computers
2 Wetsuits
3 Dive knives
2 Surface floats and reels
2 Mesh bags

Fishing gear (will be transported in and out of Monument)

4 Handlines and lures
3 Ten hook shark lines
3 Bait knives
1 Chopping board
6 Large surface buoys

Telemetry equipment (will be deployed in Monument waters)

70 V16 acoustic transmitters (will be surgically implanted in predators)
2 Satellite tags (will be attached to a tiger shark)
7 acoustic receivers (will be deployed on seabed)
Mooring supplies for 28 acoustic receivers (see Appendix 3)

Miscellaneous items (will be transported in and out of Monument)

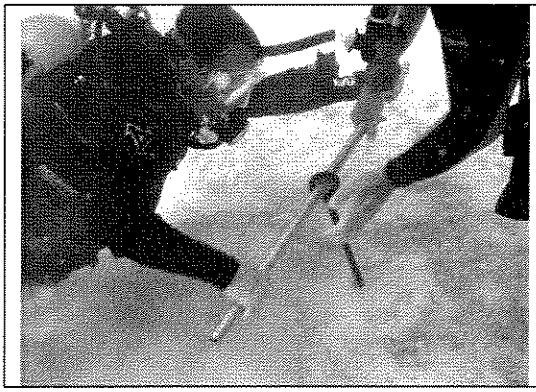
1 Laptop computer
2 Computer-receiver interfaces
Various rope working tools (fids, tape, rope cutter)
Receiver servicing supplies (batteries, electrical tape, scrubbing brushes)

Appendix 3 Receiver installments in the Monument

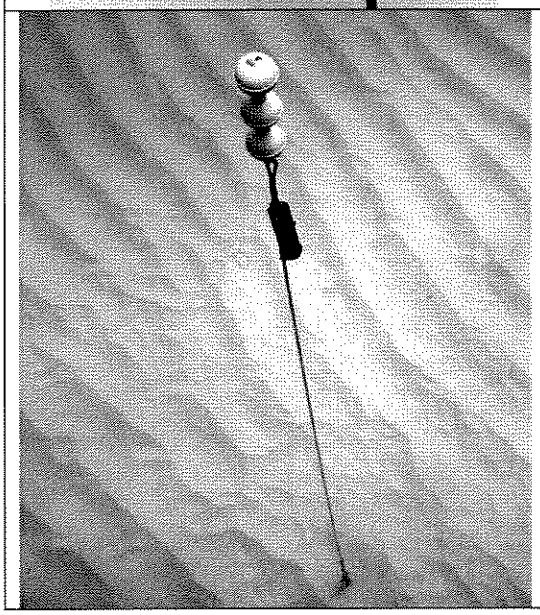
We use Vemco VR2 underwater receivers for monitoring movements of transmitter-equipped predators. The VR2 consists of a hydrophone, receiver, ID detector, data logging memory, and battery all housed in a submersible plastic case.

Vemco VR2 Receiver

Each receiver is mounted on a mooring consisting of an anchor (either a sand screw, or chain around uncolonized hard substrate), rope bridle and subsurface floats.



We use 6 ft (2 m) steel sand screws which are literally screwed into the sand, leaving an eye loop exposed. This is the point of attachment for the rope bridle.

	Anti-chafing gear (heavy duty hose) protects the rope bridle at point of contact with the sand screw eye loop. We splice the rope bridle to the sand screw *in situ*.
	The finished installation, consisting of sand screw, rope bridle, VR2 receiver and subsurface floats.

We use the sand screw installation whenever possible. In hard-bottom areas we use chain around natural arches in lieu of sand screws (the other components are identical).

We service these installations every 6-12 months, at which time we completely replace all mooring components (anchors, rope bridles, floats), and download and re-battery the receivers.

We plan to maintain these installations for the duration of the acoustic monitoring research (at least 2 years). We will remove these installations on completion of the research. Removal is straightforward, takes less than 10 minutes per installation and leaves nothing behind.

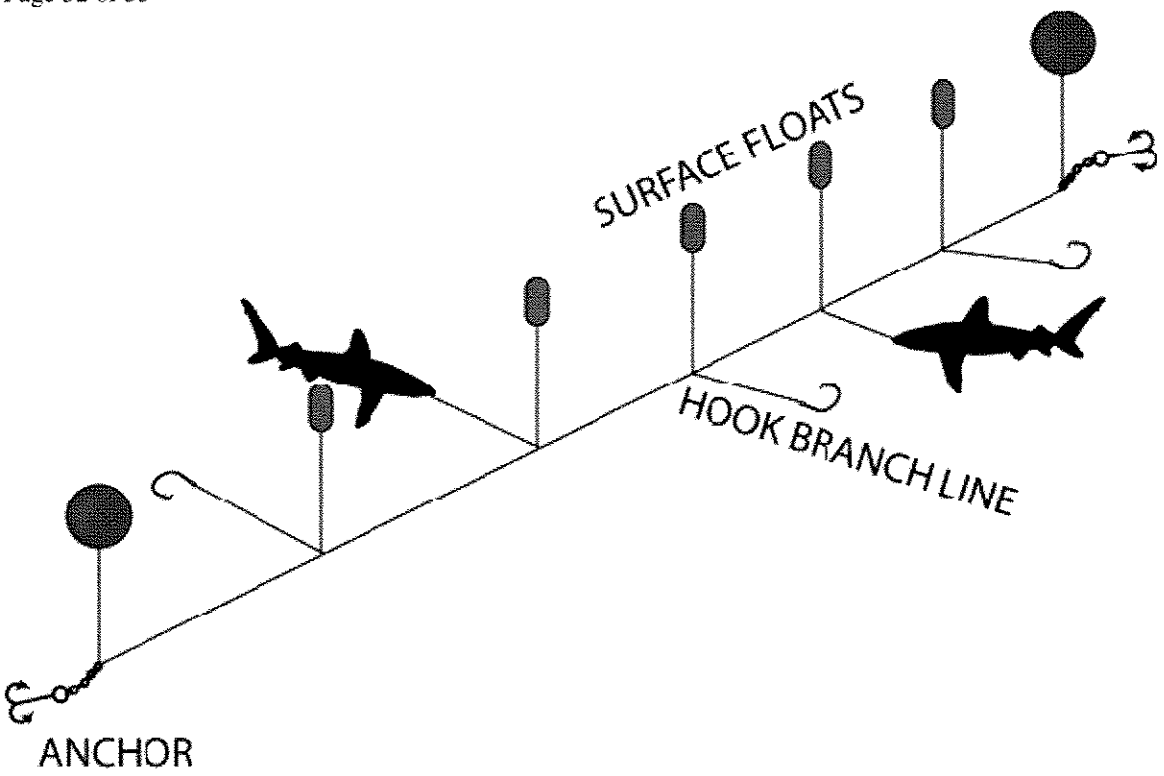
Carl Meyer – Permit Amendment Request
Shark – Monkseal Interaction Study

I am requesting a permit amendment to conduct shark tagging research that is ancillary to my existing proposed scope of work but has direct management relevance. If reviewers do not support the specific research activities proposed in this amendment request then I will omit this component to enable my original permit request to move forward.

Statement of problem and proposed methodology

Shark predation on monk seal pups is thought to be a major contributory factor to monk seal population decline at French Frigate Shoals Atoll (FFS) (Bertilsson-Friedman 2006). Galapagos sharks are the primary species suspected of taking monk seal pups at various pupping sites (small sandy islands) within the lagoon at FFS (Bertilsson-Friedman 2006). We propose using acoustic monitoring to quantify Galapagos shark movement patterns at pupping sites in order to provide managers with empirical data that could be used to forecast high pup predation risk times (Lowe et al. 2006, Meyer et al. 2007a,b). Knowing when sharks are most likely to visit pupping sites could allow development of non-lethal intervention tactics such as strategic stationing of personnel on pupping islands to discourage sharks. We would create acoustic receiver 'curtains' around pupping sites (e.g. Trig Island), and equip Galapagos sharks captured at the pupping sites with small acoustic transmitters (Lowe et al. 2006, Meyer et al. 2007a,b). This study design will enable us to determine when transmitter-equipped sharks are coming into the vicinity of these pupping sites. We will also deploy tide and current dataloggers to collect physical oceanographic data at pupping sites. Combining these technologies will allow us to determine which parameters (e.g., day, night, tide & current direction/strength) are robust predictors of increased shark activity at pupping sites. These empirical data could help managers to forecast high pup predation risk times and apply non-lethal intervention tactics such as stationing personnel on pupping islands during these times.

Previous attempts to catch Galapagos sharks for acoustic monitoring research around Trig Island and other locations inside the FFS lagoon have been made using a single baited hook deployed from a small skiff (Lowe et al. 2006). These were largely unsuccessful (4 Galapagos sharks captured during 274h of fishing = 0.015 Galapagos sharks h^{-1}) because Galapagos sharks were rarely seen, and were shy and difficult to capture in the presence of humans and boats (Lowe et al. 2006). We are proposing a new 5 hook shark line capture method to increase the catch rate of Galapagos sharks. This fishing gear is illustrated in the schematic below.



Deploying the gear in this way will allow the boat to remain several hundred meters away from the fishing site and hence avoid scaring away Galapagos sharks. The surface floats attached direct to each hook will allow observers (including FWS and NMFS monk seal personnel) to know immediately when a shark is hooked and retrieve the gear in order to tag and release the captured animal. We propose limited testing (five 3h sets) of this gear at Tern Island FFS (a less sensitive site for monk seals than Trig Island) to determine whether this new method significantly increases Galapagos shark catch rates without bycatch mortality. If these tests are successful (i.e. if we catch at least 1 galapagos shark in 15h of fishing and experience no bycatch mortality) then we will request a new permit to use this method closer to pupping sites that are locations of major pup mortality from shark predation (e.g. Trig Island).

References

Bertilsson-Friedman P. (2006) Distribution and frequencies of shark-inflicted injuries to the endangered Hawaiian monk seal (*Monachus schauinslandi*). Journal of Zoology 268: 361-368

Lowe CG, Wetherbee BM, Meyer CG. (2006) Using acoustic telemetry monitoring techniques to quantify movement patterns and site fidelity of sharks and giant trevally around French Frigate Shoals and Midway Atoll. Atoll Research Bulletin. 543: 281-303.

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Meyer CG, Papastamatiou YP, Holland KN. (2007b) Seasonal, diel and tidal movements of green jobfish (*Aprion virescens*, Lutjanidae) at remote Hawaiian atolls: Implications for Marine Protected Area design. Marine Biology. DOI 10.1007/s00227-007-0647-7